

## WHAT IS CLAIMED IS:

1. A broad spectrum neutron detector comprising a thermal neutron sensitive scintillator film interleaved with a hydrogenous thermalizing media.
2. The neutron detector of claim 1 wherein the thermal neutron sensitive scintillator film comprises a material selected from the group consisting of  $^6\text{Li}$ -ZnS,  $^{10}\text{BN}$ , and other alpha particle sensitive phosphors doped with  $^6\text{Li}$  or  $^{10}\text{B}$ .
3. The neutron detector of claim 1 wherein the hydrogenous thermalizing media comprises acrylic.
4. The neutron detector of claim 1 wherein the thermal neutron sensitive scintillator film has a layer thickness of about 0.1 mm to about 0.5 mm.
5. The neutron detector of claim 1 wherein the thermalizing media has a layer thickness of about 0.5 cm to about 1.5 cm.
6. The neutron detector of claim 1 further comprising a photo-sensor.
7. The neutron detector of claim 1 further comprising a wavelength shifter.
8. A portal detector comprising the neutron detector of claim 1.

9. A handheld instrument comprising the neutron detector of claim 1.
10. A neutron detector comprising a plurality of  $^6\text{Li-ZnS}$  films optically coupled to a light guide-thermalizing media comprising a plurality of acrylic layers.
11. The neutron detector of claim 10 comprising at least four  $^6\text{Li-ZnS}$  films and at least five acrylic layers.
12. The neutron detector of claim 10 wherein each of the  $^6\text{Li-ZnS}$  films has a thickness of about 0.1 mm to about 0.5 mm.
13. The neutron detector of claim 10 wherein each of the high density polyethylene layers has a thickness of about 0.5 cm to about 1.5 cm.
14. The neutron detector of claim 10 further comprising a photo-sensor.
15. The neutron detector of claim 10 further comprising a wavelength shifter.
16. A portal detector comprising the neutron detector of claim 10.
17. A handheld instrument comprising the neutron detector of claim 10.

18. A neutron detector comprising:
- a thermal neutron sensing scintillator comprising at least four  $^6\text{Li-ZnS}$  films interleaved with and optically coupled to a light guide-thermalizing media comprising at least five acrylic layers;
  - a reflecting surface substantially enveloping said interleaved layers, wherein said reflecting surface comprises a tapered portion extending from an end of said interleaved layers for guiding light to a narrowed section; and
  - a photo-sensor located at the narrowed section of the tapered portion.
19. A portal detector comprising the neutron detector of claim 18.
20. A handheld instrument comprising the neutron detector of claim 18.